

### **AMENDMENTS TO THE CLAIMS**

The following listing of claims will replace all prior versions, and listing of claims in the application:

#### **LISTING OF CLAIMS:**

1. (Currently amended) A hinge apparatus for a door comprising:

a tubular housing;

a housing upper sealing packing at the center of which a throughhole is formed and which is combined with the upper end of the housing in order to seal the upper portion of the housing;

a cam shaft including a cylindrical body having first and second ascending and descending guide holes penetratively formed into a spiral shape of a mutually movable symmetrical structure along the outer circumferential surface, respectively, and a shaft protruding out of the housing through the throughhole of the upper packing from the upper end of the cylindrical body, the cam shaft rotating by an external force relative to the housing when a door rotates;

a cylindrical guide tube which is fixedly installed in the inner circumferential portion of the housing, in which first and second vertical guide holes are formed up and down at positions opposing each other, and the cylindrical body of the cam shaft is rotatably installed in the inner circumferential portion of the housing;

a guide pin both ends of which are combined with the first and second vertical guide holes through the first and second ascending and descending guide holes, respectively;

a piston rod on the upper end of which the central portion of the guide pin is penetratively combined and which ascends and descends along the inner circumferential surface of the cylindrical body of the cam shaft in a sliding method via the first and second vertical guide holes according to rotation of the cam shaft, in which a recessed groove communicating with the outer circumferential portion is formed in the lower portion of the piston rod;

a piston which ascends and descends according to movement of the piston rod, and whose outer circumferential portion is slidably coupled with the inner circumferential portion of the housing to partition the inner space of the housing into an upper chamber and a lower chamber, in which the lower end of the piston rod is coupled with the central throughhole formed in the central portion thereof, and a first oil path communicating the upper chamber and the lower chamber with each other via the piston rod and the central throughhole is formed;

at least one check valve which is installed in the piston and is opened during the time when the piston descends, and is closed during the time when the piston ascends, to thereby selectively form a ~~second oil path communicating~~ unidirectional communication between the upper chamber and the lower chamber ~~with each other;~~

an elastic member which is installed in the lower chamber to elastically support the piston, and provides an elastic force for making the piston ascend during return of the piston after descending of the piston according to opening of the door;

means ~~a speed adjustment unit~~ for adjusting an amount of oil flowing from the upper chamber to the lower chamber via the first oil path responsive ~~according to~~ an escalated height of the piston rod when the piston rod ascends along the inner circumferential surface of the cam shaft body, ~~according to ascending of the piston~~ during the return of the door, to thereby control an escalating speed of the piston in multiple steps; and

a housing lower packing which is coupled with the lower portion of the housing to seal the lower chamber.

2. (Currently amended) The hinge apparatus for a door according to claim 1, wherein said ~~speed adjustment unit~~ means for adjusting an amount of oil flowing comprises at least one speed adjustment oil path internally connected with a recessed groove of the piston rod communicating with the first oil path perpendicularly from the outer circumferential surface of the piston rod, wherein the speed adjustment oil path is closed by the inner circumferential surface of the cam shaft in the case that the door opening angle reaches a set angle.

3. (Original) The hinge apparatus for a door according to claim 1, wherein said first and second ascending and descending guide holes are divided into a first ascending and descending section having a door opening angle ranging between  $0^{\circ}$  and  $15^{\circ}$ , a second ascending and descending section having a door opening angle ranging between  $15^{\circ}$  and  $90^{\circ}$ , a first stop section having a door opening angle ranging between  $90^{\circ}$  and  $130^{\circ}$ , and a second stop section having a door opening angle ranging between  $130^{\circ}$  and  $160^{\circ}$ .

4. (Original) The hinge apparatus for a door according to claim 3, wherein the cam diagram angle in the first ascending and descending section is established between  $45^{\circ}$  and  $65^{\circ}$  and the cam diagram angle in the second ascending and descending section is established between  $10^{\circ}$  and  $45^{\circ}$  when the door is a left/right opening and closing door.

5. (Original) The hinge apparatus for a door according to claim 3, wherein the cam diagram angle in the first ascending and descending section is established between  $30^{\circ}$  and  $45^{\circ}$  and the cam diagram angle in the second ascending and descending section is established between  $10^{\circ}$  and  $45^{\circ}$  when the door is an up/down opening and closing door.

6. (Original) The hinge apparatus for a door according to claim 3, wherein the first ascending and descending section is a low-speed return section during an automatic return of a door, in which a closing force loss is supplemented by setting the cam diagram angle of the first ascending and descending section to be relatively greater than that of the second ascending and descending section, to thus enhance an efficiency of ascending of the piston,

the second ascending and descending section is a high-speed return section during an automatic return of a door, in which an opening force increment is supplemented by setting the cam diagram angle of the second ascending and descending section to be relatively smaller than that of the first ascending and descending section, to thereby increase a rotating efficiency of the cam shaft proportionally when the door is opened,

the first stop section is a section where the cam diagram angle is set to be zero (0) to thus interrupt an automatic return of the door and to thereby maintain an angle at the state where the door is opened, and

the second stop section is a door stopping force reinforcing section, in which the directions of the ascending and descending guide holes are established into those of the first and second ascending and descending sections.

7. (Original) The hinge apparatus for a door according to claim 1, further comprising an overspeed prevention unit which is incorporated in a recessed

groove located in the lower end of the piston rod combined with the central throughhole of the piston, for closing the first oil path in the case that the piston ascends at excessive high speed.

8. (Original) The hinge apparatus for a door according to claim 1, further comprising:

a support bracket whose one end is fixed on the lower surface or upper surface of the main body of the hinge apparatus, and whose other end extended from the main body of the hinge apparatus supports the rotational axis of the door pivotally;

a flange which is fixed on the housing upper sealing packing and the lower surface or upper surface of the door so that the housing is supported at the state where the housing is buried into a recessed groove formed on the lower surface or upper surface of the door at a certain distance from the rotational axis of the door;

a driving link whose one end is fixedly combined with the shaft of the cam shaft; and

a following link whose one end is pivotally combined with the other end of the driving link and whose other end is hingedly combined with the hinge axis located on the main body of the hinge apparatus of the support bracket.

9. (Original) The hinge apparatus for a door according to claim 1, wherein the shaft of the cam shaft is combined with a first hinge knuckle in a movable hinge plate and the housing is combined with a second hinge knuckle in a fixed hinge plate, so that the shaft is installed in a hinge fashion between the door and door frame.

10. (Original) The hinge apparatus for a door according to claim 1, wherein the housing in the hinge apparatus is buried and installed in the door, and the shaft in the cam shaft is fixedly combined with the door frame.

11. (Original) The hinge apparatus for a door according to claim 1, further comprising:

a pair of burial grooves which bury the housing the hinge apparatus in both ends of the door;

a pair of main body fixing units which protrude adjacent to both side ends of the door in which a spline boss groove is formed;

a pair of hinge pins whose inner and outer circumferential portions are formed of a polygonal shape so as to be mutually engaged with shafts of the cam shaft formed of a polygonal shape; and

a pair of stop angle adjustment nuts having a polygonal inner circumferential portion so that the outer circumference of the polygonal hinge pin

is combined with the throughhole in the inner circumferential portion and an outer circumferential portion which is formed of a spline shape and is fixedly inserted into a spline boss groove.

12. (Original) The hinge apparatus for a door according to claim 1, further comprising:

a control pipe whose upper end is combined with the central throughhole of the piston to thereby form the third oil path communicating with the first oil path and whose lower end is combined with a head sealing the lower end thereof, the control pipe having a first throughhole communicating with the upper side of the head and ascending and descending in association with movement of the piston;

an outer tube at the upper side of which second and third throughholes communicating with the lower chamber are formed, and at the lower side of which a fourth throughhole communicating with the lower chamber is formed;

a lower chamber sealing packing which is combined with the lower end of the housing in order to seal the lower chamber in which the lower end of the outer tube is fixed to the central throughhole;

an inner tube which has an inner diameter corresponding to the outer diameter of the control pipe so that the head is slidably combined with the inner



tube, and an outer diameter corresponding to the inner diameter of the outer tube, so as to be combined with the inner portion of the outer tube, and which has fifth and sixth throughholes corresponding to the second and third throughholes in order to communicate the upper area partitioned by the head with the lower chamber, and a seventh throughhole corresponding to the fourth throughhole in order to communicate the lower area below the head with the lower chamber;

an outer tube sealing packing which is combined with the outer circumferential portion of the control pipe and the upper portion of the outer tube to thus separate the upper area of the inner tube from the lower chamber and simultaneously slidably support the control pipe; and

an inner tube lower sealing packing into an upper groove of which the lower portion of the inner tube is fixed, to thereby seal the lower portion of the inner tube,

wherein the second and fifth throughholes and the third and sixth throughholes form first and second speed adjustment oil paths, respectively, and the fourth and seventh throughholes form a fourth oil path.

13. (Original) The hinge apparatus for a door according to claim 1, further comprising:

a control pipe whose upper end is combined with the central throughhole of the piston to thereby form the third oil path communicating with

the first oil path and whose lower end is combined with a head sealing the lower end thereof, the control pipe having a first throughhole communicating with the upper side of the head and ascending and descending in association with movement of the piston;

an outer tube in the inner circumferential portion of the upper end of which the head of the control pipe is accommodated;

a lower chamber sealing packing which is combined with the lower end of the housing in order to seal the lower chamber in which the lower end of the outer tube is fixed to the central throughhole;

an inner tube which has an inner diameter corresponding to the outer diameter of the control pipe so that the head is slidably combined with the inner tube, and whose inner portion is partitioned into an upper area and a lower area by the head and rotatably combined with the inner portion of the outer tube;

an outer tube sealing packing which is combined between the outer circumferential portion of the control pipe and the upper portion of the outer tube to thus separate the upper area of the inner tube from the lower chamber and simultaneously slidably support the control pipe;

an inner tube lower sealing packing into an upper groove of which the lower portion of the inner tube is fixed, to thereby seal the lower portion of the inner tube;

first and second speed adjustment oil paths which are formed at a certain interval and on the same level of the upper sides of the inner tube and the outer tube, and communicate the upper area of the inner tube with the lower chamber; and

a fourth oil path communicating the lower area of the inner tube with the lower chamber,

wherein the second speed adjustment oil path is closed by the head of the control pipe according to ascending of the control pipe in the case that the door is near the initial state.

14. (Original) The hinge apparatus for a door according to claim 13, further comprising a speed change unit which adjusts an amount of oil flowing through the first and second speed adjustment oil paths to the lower chamber, to thereby change an ascending speed of the piston during an automatic return of the door.

15. (Currently amended) A hinge apparatus for a door comprising:

a tubular housing;

a housing upper sealing packing at the center of which a throughhole is formed and which is combined with the upper end of the housing in order to seal the upper portion of the housing;

a cam shaft through which first and second ascending and descending guide holes are penetratively formed in which the first and second ascending and descending guide holes are formed into a spiral shape of a mutually movable symmetrical structure along the outer circumferential surface of a cylindrical body, respectively, and which rotates by an external force relative to the housing when the shaft protrudes out of the housing through the throughhole of the upper packing from the upper end of the cylindrical body and thus a door rotates;

a cylindrical guide tube which is fixedly installed in the inner circumferential portion of the housing, in which first and second vertical guide holes are formed up and down at positions opposing each other, and the cylindrical body of the cam shaft is rotatably installed in the inner circumferential portion of the housing;

a guide pin both ends of which are combined with the first and second vertical guide holes through the first and second ascending and descending guide holes, respectively;

a piston rod on the upper end of which the central portion of the guide pin is penetratively combined and which ascends and descends via the first and second vertical guide holes according to rotation of the cam shaft, in which a recessed groove communicating with the outer circumferential portion is formed in the lower portion of the piston rod;

a piston which ascends and descends according to movement of the piston rod, and whose outer circumferential portion is slidably coupled with the inner circumferential portion of the housing to partition the inner space of the housing into an upper chamber and a lower chamber, in which the lower end of the piston rod is coupled with the central throughhole formed in the central portion thereof, and a first oil path communicating the upper chamber and the lower chamber with each other via the central throughhole of the piston rod is formed;

at least one check valve which is installed in the piston and is opened during the time when the piston descends, and is closed during the time when the piston ascends, to thereby selectively form a ~~second oil path communicating~~ unidirectional communication between the upper chamber and the lower chamber ~~with each other~~;

an elastic member which is installed in the lower chamber to elastically support the piston, and provides an elastic force for making the elastic member compressed during the time when the piston descends, according to opening of the door, and making the piston ascend during return of the door; and

a housing lower packing which is coupled with the lower portion of the housing to seal the lower chamber,

wherein diameter of an exit of the central throughhole is formed relatively smaller than that of the check valve, the check valve is closed during the

return of the door, oil flows from the upper chamber to the lower chamber via the first oil path, to thereby make the piston ascend at retarded speed, and

wherein a number of horizontal throughholes of the piston rod form a ~~speed-adjustment unit~~ mechanism for adjusting an ascending speed of the piston.

16. (Currently amended) A multipurpose hinge apparatus comprising:

a cylindrical housing whose inner circumferential portion is cylindrically formed;

a housing upper sealing packing at the center of which a throughhole is formed and which is combined with the upper end of the housing in order to seal the upper portion of the housing;

a cam shaft through which first and second ascending and descending guide holes are penetratively formed in which the first and second ascending and descending guide holes are formed into a spiral shape of a mutually movable symmetrical structure along the outer circumferential surface of a cylindrical body, respectively, and which rotates by an external force relative to the housing when the shaft protrudes out of the housing through the throughhole of the upper packing from the upper end of the cylindrical body and thus a door rotates;

a cylindrical guide tube which is fixedly installed in the inner circumferential portion of the housing, in which first and second vertical guide

holes are formed up and down at positions opposing each other, and the cylindrical body of the cam shaft is rotatably installed in the inner circumferential portion of the housing;

a guide pin both ends of which are combined with the first and second vertical guide holes through the first and second ascending and descending guide holes, respectively;

a piston rod on the upper end of which the central portion of the guide pin is penetratively combined and which ascends and descends via the first and second vertical guide holes according to rotation of the cam shaft, in which a return oil path communicating with the outer circumferential portion thereof is formed on an oil path elongate groove which is opened downwards;

an oil path adjustment unit which is in the oil path elongate groove of the piston rod, having an inner diameter smaller than that of the oil path groove, in which a first speed adjustment oil path of an orifice shape whose diameter becomes gradually narrow is formed therein so that an amount of oil flowing inside is adjusted;

a piston which ascends and descends according to movement of the piston rod, and whose outer circumferential portion is slidably coupled with the inner circumferential portion of the housing to partition the inner space of the housing into an upper chamber and a lower chamber, in which the lower end of the

piston rod is coupled with the central throughhole formed in the central portion thereof;

at least one check valve which is installed in the piston and is opened during the time when the piston descends, and is closed during the time when the piston ascends, to thereby selectively form a ~~second speed adjustment oil path communicating~~ unidirectional communication between the upper chamber and the lower chamber ~~with each other~~;

an elastic member which is installed in the lower chamber to elastically support the piston, and provides an elastic force for making the elastic member compressed during the time when the piston descends, according to opening of the door, and making the piston ascend during return of the door;

a housing lower sealing packing which is coupled with the lower portion of the housing; and

a hydraulic control rod whose one end is supported to the housing lower packing and other end is inserted into the first speed adjustment oil path, in which diameter of the other end of the hydraulic control rod is changed in multiple steps so that cross-sectional area of the first speed adjustment oil path through which oil flows according to movement of the piston rod up and down is changed in multiple steps,

wherein the other end of the hydraulic control rod is formed of a first diameter portion having a first diameter, a second diameter portion having a



diameter smaller than the first diameter, and a spherical portion having a diameter identical with the first diameter, and an automatic return speed of a door is changed into low speed, high speed and low speed, in sequence.

17. (Original) The multipurpose hinge apparatus according to claim 16, wherein the first and second ascending and descending guide holes each comprise an ascending and descending section which is formed with a certain width through which the guide pin can be inserted in a slope downwards on the outer circumferential surface of the cam shaft; a first stop section formed to have the same level in the lower end of the ascending and descending section so that the guide pin does not ascend and descend; and a second stop section which is bent and formed in a slope from the end of the first stop section toward the upper portion thereof so that the guide pin does not move to the ascending and descending section again.

18. (Currently amended) A hinge apparatus for a door comprising:

- a tubular housing;
- a housing upper sealing packing at the center of which a throughhole is formed and which is combined with the upper end of the housing in order to seal the upper portion of the housing;

a cam shaft through which first and second ascending and descending guide holes are penetratively formed in which the first and second ascending and descending guide holes are formed into a spiral shape of a mutually movable symmetrical structure along the outer circumferential surface of a cylindrical body, respectively, and which rotates by an external force relative to the housing when the shaft protrudes out of the housing through the throughhole of the upper packing from the upper end of the cylindrical body and thus a door rotates;

a cylindrical guide tube which is fixedly installed in the inner circumferential portion of the housing, in which first and second vertical guide holes are formed up and down at positions opposing each other, and the cylindrical body of the cam shaft is rotatably installed in the inner circumferential portion of the housing; a guide pin both ends of which are combined with the first and second vertical guide holes through the first and second ascending and descending guide holes, respectively;

a piston rod on the upper end of which the central portion of the guide pin is penetratively combined and which ascends and descends according to the first and second vertical guide holes in accordance with rotation of the cam shaft, in which a recessed groove communicating with the outer circumferential portion is formed in the lower portion of the piston rod;

a piston which ascends and descends according to movement of the piston rod, and whose outer circumferential portion is slidably coupled with the inner circumferential portion of the housing to partition the inner space of the housing into an upper chamber and a lower chamber, in which the lower end of the piston rod is coupled with the central throughhole formed in the central portion thereof, and a first oil path communicating the upper chamber and the lower chamber with each other via the central throughhole of the piston rod is formed;

at least one check valve which is installed in the piston and is opened during the time when the piston descends, and is closed during the time when the piston ascends, to thereby selectively form a ~~oil path communicating~~ unidirectional communication between the upper chamber and the lower chamber ~~with each other~~;

an elastic member which is installed in the lower chamber to elastically support the piston, and provides an elastic force for making the elastic member compressed during the time when the piston descends, according to opening of the door, and making the piston ascend during return of the door;

a control pipe whose upper end is combined with the central throughhole of the piston to thereby form a second oil path communicating with the first oil path and whose lower end is combined with a head sealing the lower end thereof, the control pipe having a first throughhole communicating with the

upper side of the head and ascending and descending in association with movement of the piston;

an outer tube in the inner circumferential portion of the upper end of which the head of the control pipe is accommodated;

a lower chamber sealing packing which is combined with the lower end of the housing in order to seal the lower chamber in which the lower end of the outer tube is fixed to the central throughhole;

an inner tube which has an inner diameter corresponding to the outer diameter of the control pipe so that the head is slidably combined with the inner tube, and whose inner portion is partitioned into an upper area and a lower area by the head and rotatably combined with the inner portion of the outer tube;

an outer tube upper sealing packing which is combined between the outer circumferential portion of the control pipe and the upper portion of the outer tube to thus separate the upper area of the inner tube from the lower chamber and simultaneously slidably support the control pipe;

an inner tube lower sealing packing into an upper groove of which the lower portion of the inner tube is fixed, to thereby seal the lower portion of the inner tube;

a housing lower packing which is coupled with the lower portion of the housing to seal the lower chamber;

first and second speed adjustment oil paths which are formed at a certain interval and on the same level of the upper sides of the inner tube and the outer tube, and communicate the upper area of the inner tube with the lower chamber; and

a third oil path communicating the lower area of the inner tube with the lower chamber,

wherein the second speed adjustment oil path is closed by the head of the control pipe according to ascending of the control pipe in the case that the door is near the initial state.